Coastwide Reference Monitoring System (CRMS)

Site Level Report Card

Site: CRMS5373

Year: 2013

1/15/2015

About the program

In 1990, the U.S. Congress enacted the Coastal Wetlands Planning, Protection and Restoration Act (CWPPRA) in response to the growing awareness of Louisiana's land loss crisis. The CWPPRA was the first federal, statutorily mandated program with a stable source of federal funds dedicated exclusively to the short- and long-term restoration of the coastal wetlands of Louisiana. To date, the CWPPRA program has constructed more than 75 restoration projects. These projects use a variety of methods to restore, protect, and create coastal wetland habitat including: diversions of freshwater and sediments to improve marsh vegetation; dredged material placement for marsh creation; shoreline protection; sediment and nutrient trapping; hydrologic restoration through outfall, marsh, and delta management; barrier island restoration; and vegetation planting projects.

Need for a Monitoring System

Louisiana's coastal protection and restoration efforts, implemented through numerous CWPPRA projects, require monitoring and evaluation of project effectiveness and cumulative effects of all projects to achieve a sustainable coastal environment. In 2003, the CWPPRA Task Force approved the implementation of a Coastwide Reference Monitoring System (CRMS) as a means to monitor and evaluate the effectiveness of CWPPRA projects at three levels: project, region, and coastwide (Steyer et al., 2003). The CRMS network is currently funded through CWPPRA and the state of Louisiana and provides data for a variety of user groups including resource managers, academics, landowners, and researchers.

CRMS Approach and Design

The CRMS approach includes a suite of sites (391) that encompass a range of ecological conditions across the coast. The CRMS site locations were selected randomly throughout the coastal zone. Sites represent the entire range of ecological variability within a degraded coastal landscape. Sites are located within (project sites) and outside (reference sites) of coastal restoration projects. Trajectories of changing conditions in reference sites are compared with trajectories of change within project sites through time. The CRMS design not only allows for monitoring and evaluating the effectiveness of each project but will also support ongoing evaluation of the cumulative effects of all CWPPRA projects throughout the coastal ecosystems of Louisiana. More information about the CRMS project is provided within a USGS factsheet (http://pubs.usgs.gov/fs/2010/3018/).

About the Interactive Report Card

Through the Coastal Wetlands Planning, Protection, and Restoration Act (CWPPRA) a comprehensive, standardized monitoring and assessment program has been developed to evaluate coastal restoration projects throughout the Louisiana coastal zone. The Coastwide Reference Monitoring System (CRMS) collects monitoring data for numerous ecological variables. Using CRMS data, indices have been developed to assess wetland hydrology, vegetation, and soils. This interactive report card provides summary information and displays index scores for individual CRMS sites, restoration projects, hydrologic basins, and the entire Louisiana coast.

Index Development

What is an Index?

An index combines and synthesizes scientific data to help inform or assess a topic of interest. Each index helps explain the condition of a particular aspect of the coastal wetland ecosystem. By comparing indices at various time and spatial scales we can understand the overall condition of coastal wetlands in Louisiana.

How were the indices developed?

CRMS Analytical Teams, made up of agency and academic personnel, developed indices based on the suite of parameters available from the 2006 to 2009 CRMS dataset. Three indices have been developed: a floristic quality (FQI), hydrologic (HI), and submergence vulnerability (SVI), and a landscape index is currently being refined. Wetland vegetation, hydrology, and soils are undeniably interconnected and form the basis for ecological processes that ultimately influence future land change and the sustainability of coastal habitats. Although these indices have been developed using 4 years of baseline CRMS data, the indices will be refined to better define ecological relationships as the data set becomes more robust overtime.

Because no regulatory thresholds exist for the ecological parameters of interest, it was not possible to assess index scores based on previously defined values that would indicate an acceptable or unacceptable score. Therefore, for the FQI and the HI, assessments were made relative to a baseline distribution of the index scores derived from 2006 to 2009 data at CRMS sites across the Louisiana coast. Because ideal thresholds were not available for the FQI and HI, scores were classified as 'good' (green) if they exceeded the 75th percentile of index scores calculated for all CRMS sites during the baseline period, 'poor' (red) if they did not exceed the 25th percentile, or 'fair' (yellow) if they were intermediate to the 25th and 75th percentiles (Figure 1).

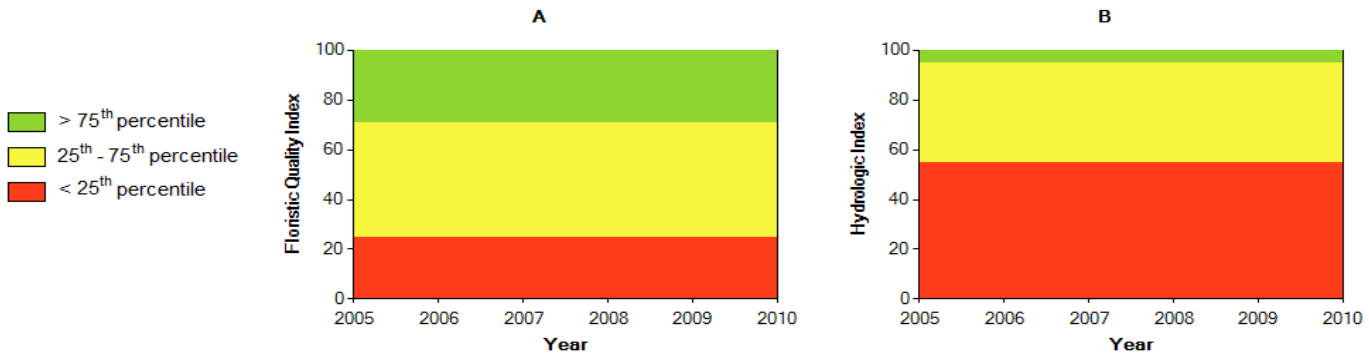

Figure 1. Example of how classifications change based on the assessment index and index score distribution. A) Floristic Quality Index distribution and B) Hydrologic Index distribution based on coastwide data from 2006 to 2009.

As shown in Figure 1A, FQI scores greater than 71% fall within the green "good" category while those less than 39% are within the red "poor" category. FQI scores between 39% and 71% are within the yellow "fair" category.

For the HI, index scores greater than 95% fall within the green "good" category while those less than 56% are within the red "poor" category. HI scores between 56% and 95% are within the yellow "fair" category (Figure 1B).

SVI scores are inversely related to flood frequency; sites with higher scores are flooded less frequently, and sites with lower scores are flooded more often. Interpretation of the SVI is based on the assumption that wetlands situated at lower elevations within the hydrologic frame are more vulnerable to future changes in sea-level, and submergence, than wetlands situated at higher elevations. Therefore, scores in the upper end of the spectrum (>50) are more favorable or "good", whereas scores in the lower end of the spectrum (<50) are less favorable or "poor" (Figure 2).

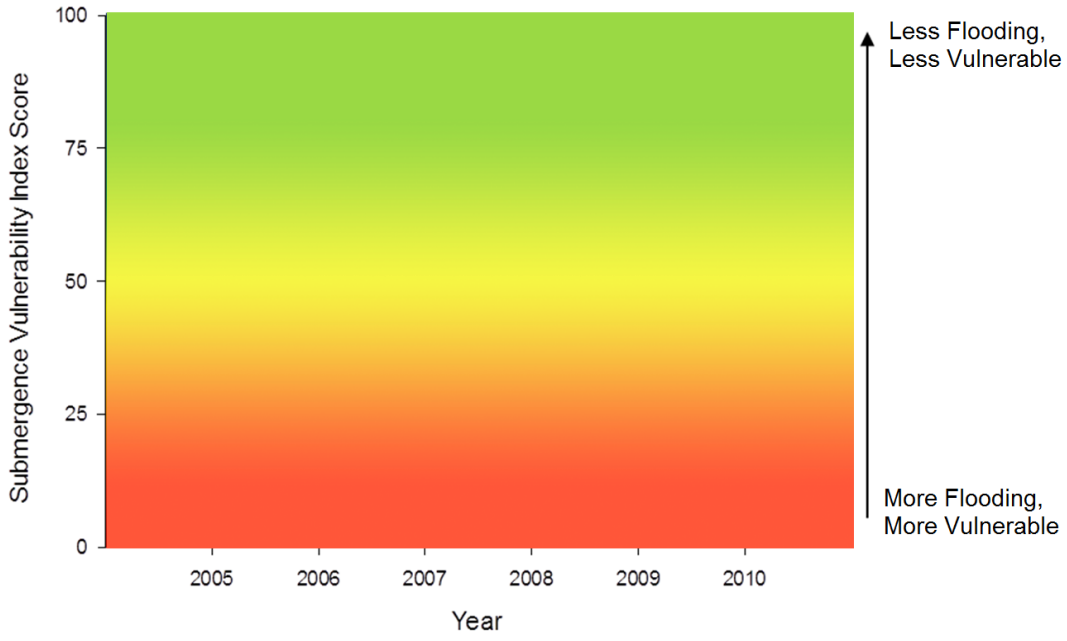

Figure 2. Example of SVI scoring scale based on the relative position of the wetland within the hydrologic frame.

Brief Description of the Indices

The Floristic Quality Index (FQI)

The Floristic Quality Index (FQI) is used throughout the world to determine wetland quality based on plant species composition for a geographic area of interest. The FQI developed with the CRMS data is specific to coastal Louisiana. It was developed by assigning a Coefficient of Conservatism (CC score) based on a species' tolerance to disturbance and fidelity to a habitat. The CC scores range from 0 to 10. Invasive plant species are scored with a 0 and plants that are dominants in vigorous coastal wetland communities are valued at 10. FQI scores from 0 to 100 are calculated for a sampling station and are based on the percent cover values and the CC scores of the species present. CRMS sites have 10 sampling stations that are sampled annually. Individual station FQI scores are averaged to obtain an overall CRMS site FQI score. For more detailed information regarding the development of the FQI see: http://pubs.usgs.gov/fs/2011/3044/ and Cretini et al. 2011.

The Hydrologic Index (HI)

The Hydrologic Index (HI) jointly assesses the suitability of two critical aspects of wetland hydrology, average salinity and percent time flooded, in maximizing vegetation primary productivity. The index incorporates continuous hourly hydrologic data into a site specific index score. The HI score (between 0 and 100) corresponds to the percent of maximum vegetation productivity expected to occur if the separate effects of salinity and inundation interact in a multiplicative fashion on vegetation productivity. Individual "index surfaces" were created for each of the vegetation types (swamp, fresh, intermediate, brackish, and saline). Relationships describing how percent maximum productivity varies with salinity and percent time flooded were taken from the Habitat Switching Module of the LCA ecosystem restoration study (U.S. Army Corps of Engineers 2004). For more information regarding the development of the HI see: http://pubs.usgs.gov/of/2012/1122/

The Submergence Vulnerability Index (SVI)

The SVI assesses a site's vulnerability to submergence due to sea-level rise, which results from the feedbacks between flooding regime, surface elevation and surface accretionary processes. The SVI incorporates several parameters representative of soil building processes and elevation change dynamics to determine the vulnerability of a site to submergence. Surface elevation change, vertical accretion, and water elevation measured at each site are used along with global eustatic sea-level rise to make direct comparisons of wetland surface elevation to local relative water-level trends. A site is scored (0-100) according to the position of the projected wetland elevation relative to the projected hydrologic frame. Sites with more frequent flooding receive lower scores and are considered more vulnerable to submergence, whereas sites that are flooded less frequently receive higher scores and are considered less vulnerable to submergence.For more detailed information on the development of the SVI see: http://pubs.usgs.gov/of/2013/1163/

Report Card Introduction Summary

The following pages provide information and graphics that can be used as a multi-scale assessment of wetland condition. The report card uses the indices developed from the CRMS dataset and displays visualizations to contextualize how individual index scores relate to those within a similar marsh type, project, basin, or all the sites throughout the coast.

Every index is not currently represented at all scales due to limitations of the data. For example, the SVI requires a minimum of 5 years of surface elevation and accretion data to calculate an index score therefore example graphics are used as placeholders where necessary.

Site Scale Assessment: CRMS5373 Floristic Quality Index (FQI)

The following graphics provide information about the CRMS site of interest with regard to the floristic quality index. These graphics provide an assessment of the vegetation quality of this site relative to other sites within a similar marsh type, basin, and coastwide.

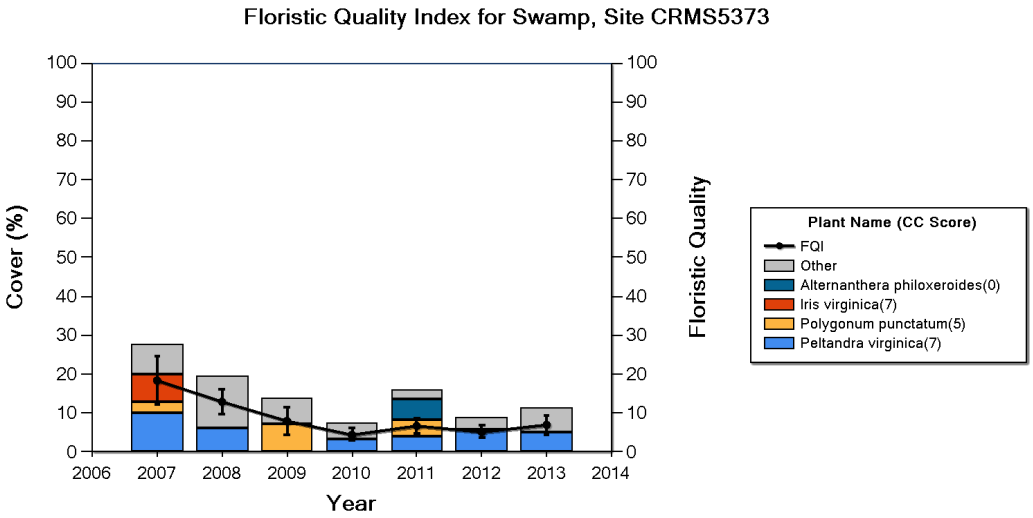

Figure 3. Floristic Quality Index for Swamp marsh and species composition for CRMS5373.

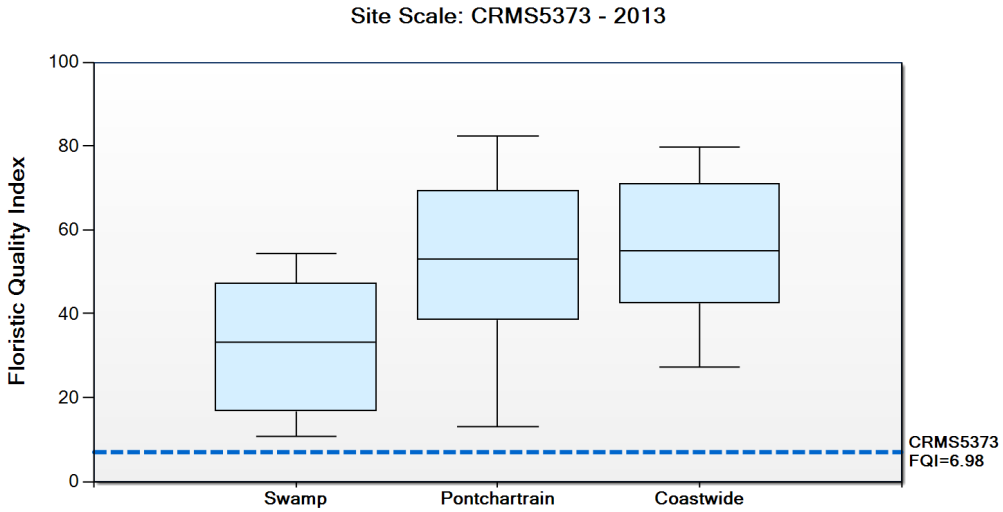

Figure 4. A CRMS site FQI score for a given year compared to the distribution of scores for all coastwide sites within the same marsh type, within the same hydrologic basin, and across the entire LA coastal zone.

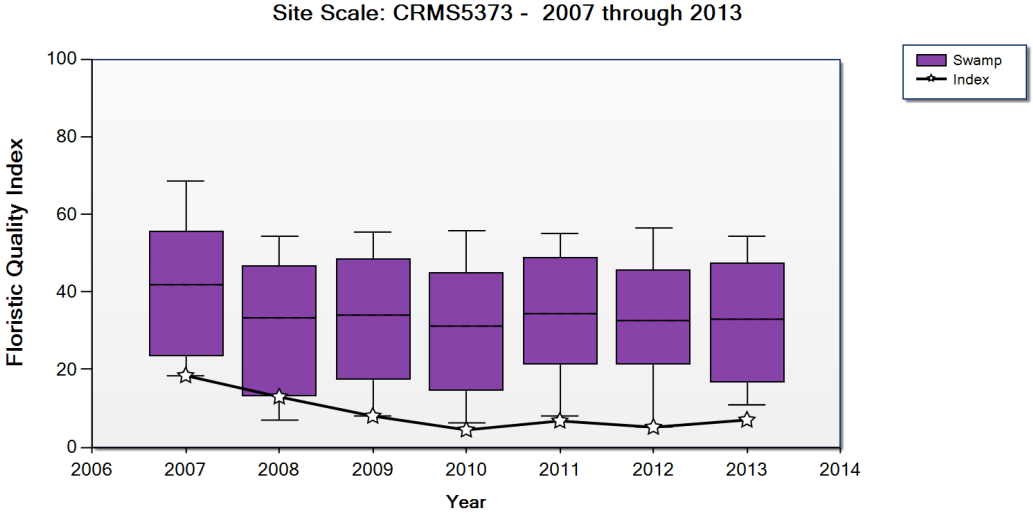

Figure 5. A time series of FQI scores for a CRMS site relative to a box plot of scores for all the sites within the same marsh type each year. Marsh type classifications for each year are based on species composition data for that year at the specific CRMS site.

Site Scale Assessment: CRMS5373 Hydrologic Index (HI)

The following graphics provide information about the CRMS site of interest with regard to the hydrologic index. These graphics present an assessment of how aspects of site specific wetland hydrology influence a particular CRMS site relative to other sites within a similar marsh type, basin, and coastwide.

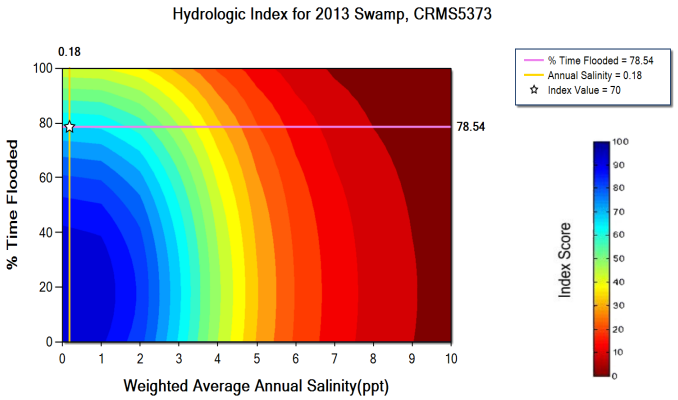

Figure 6. Hydrologic index score (indicated by color scale) based on the combined influences of average annual salinity (horizontal axis) and flood duration (vertical axis).

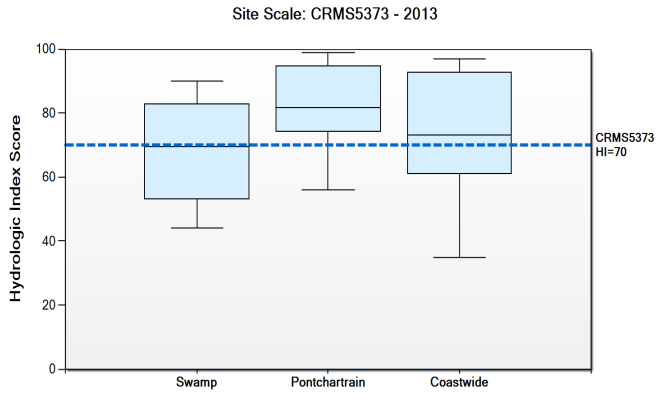

Figure 7. A CRMS site HI score for a given year compared to the distribution of scores for all coastwide sites within the same marsh type, within the same hydrologic basin, and across the entire LA coastal zone.

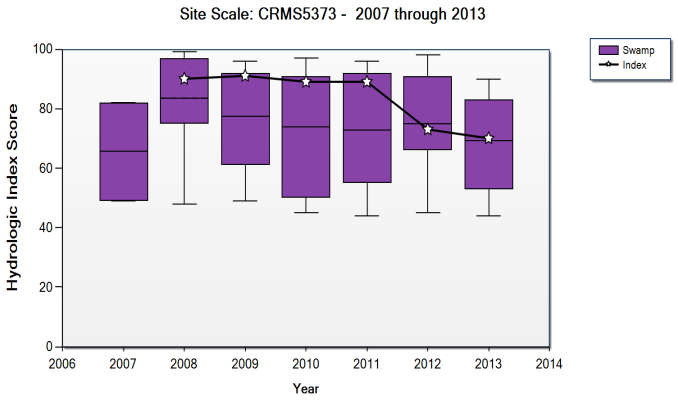

Figure 8. A time series of HI scores for a CRMS site relative to the box plot of the scores for all the sites within the same marsh type each year.

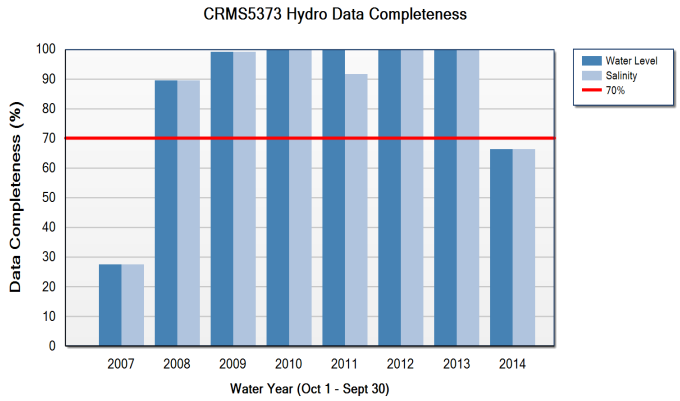

Figure 9. Hydro data completeness by year. The Hydrologic Index requires > 70% data completeness for water level and salinity datasets in a given year to calculate an HI score.

Site Scale Assessment: CRMS X Submergence Vulnerability Index (SVI)

The following graphics are examples of how the SVI will be visually represented after 5 years of surface elevation and accretion data have been collected at a CRMS site. In the spring of 2012, approximately 135 CRMS sites will have sufficient data to calculate SVI scores.

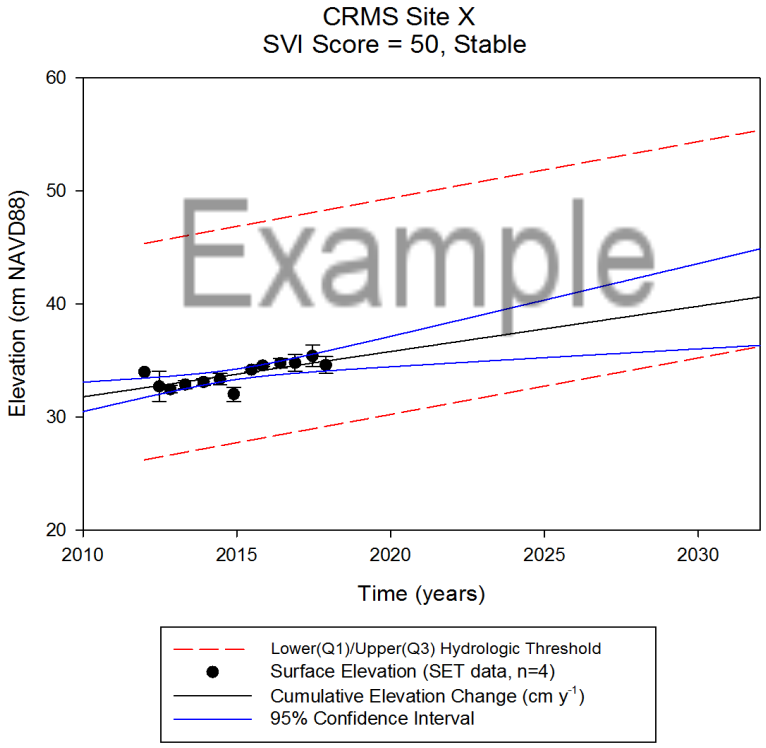

Figure 10. Submergence Vulnerability Index for CRMSX.

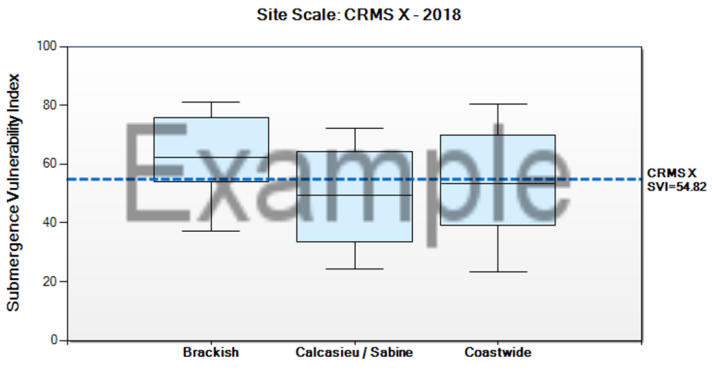

Figure 11. A CRMS site SVI score for a given year compared to the distribution of scores for sites within the same marsh type and hydrologic basin and the coastwide distribution of scores.

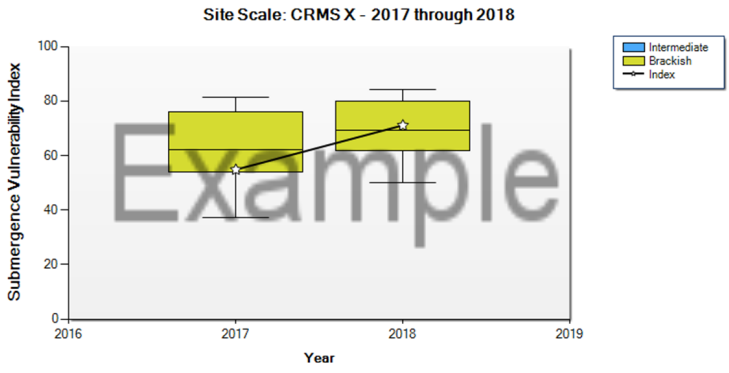

Figure 12. A time series of SVI scores for a CRMS site relative to a box plot of scores for all the sites within the same marsh type each year.

Site Scale Assessment: CRMS5373 Percent Land Change

The following graphic uses multi-temporal land:water analyses to represent how the percent of land has changed at a CRMS site through time. Percent land trends were calculated using Landsat Thematic Mapper (TM) data for 1985 -2010. Linear regressions were calculated for the period of record excluding the 2005 and 2008 dates. Post-hurricane images do not represent average conditions and exclusion was an effort to reduce the influence of transitory storm effects. The variablility in percent land data points around the slope illustrates the influence of various sources of environmental variance or classification error. Positive slopes indicate increasing percent land or historical land gain and negative slopes indicate decreasing percent land or historical land loss (Couvillion et al., 2011).

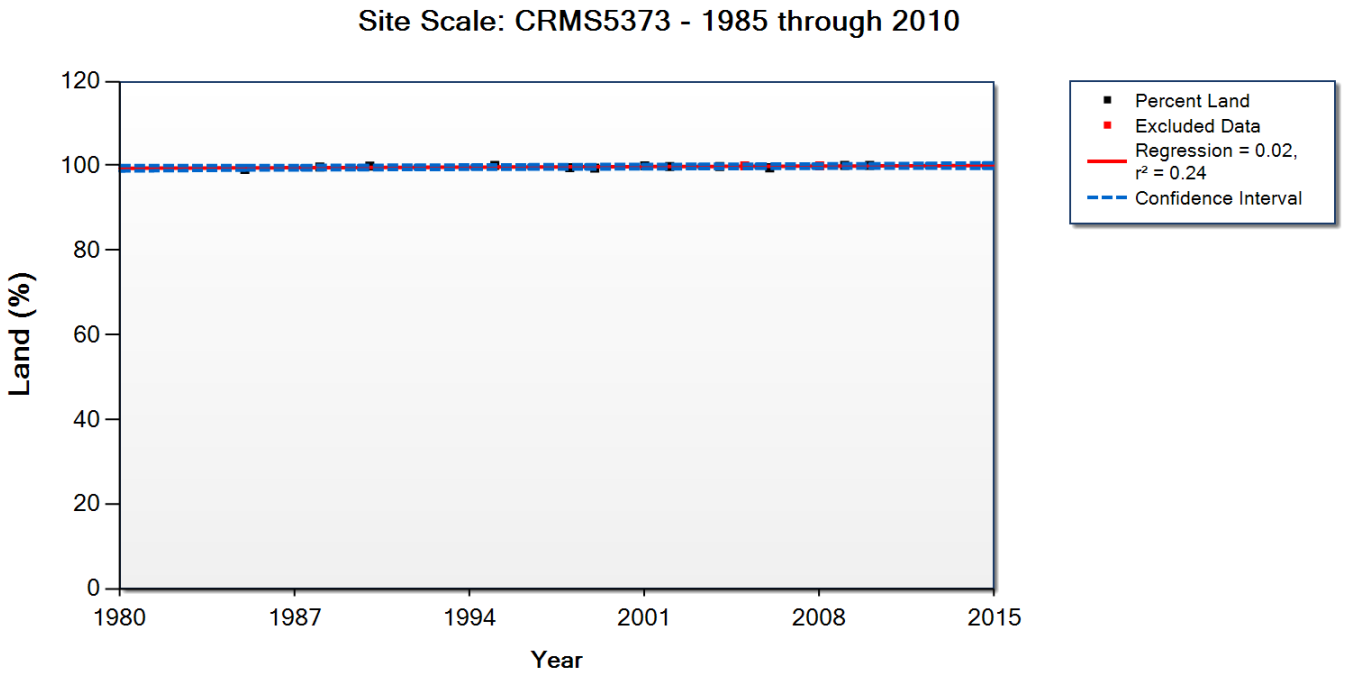

Figure 13. Site scale percent land change for CRMS5373. Percent land values are displayed for all cloud free TM images available for 1925-2010. The red line depicts the percent land trend for the entire period of record. Data points were excluded immediately following the hurricanes of 2005 and 2008 because they do not represent average conditions.

Basin Scale Assessment: Pontchartrain Floristic Quality Index (FQI)

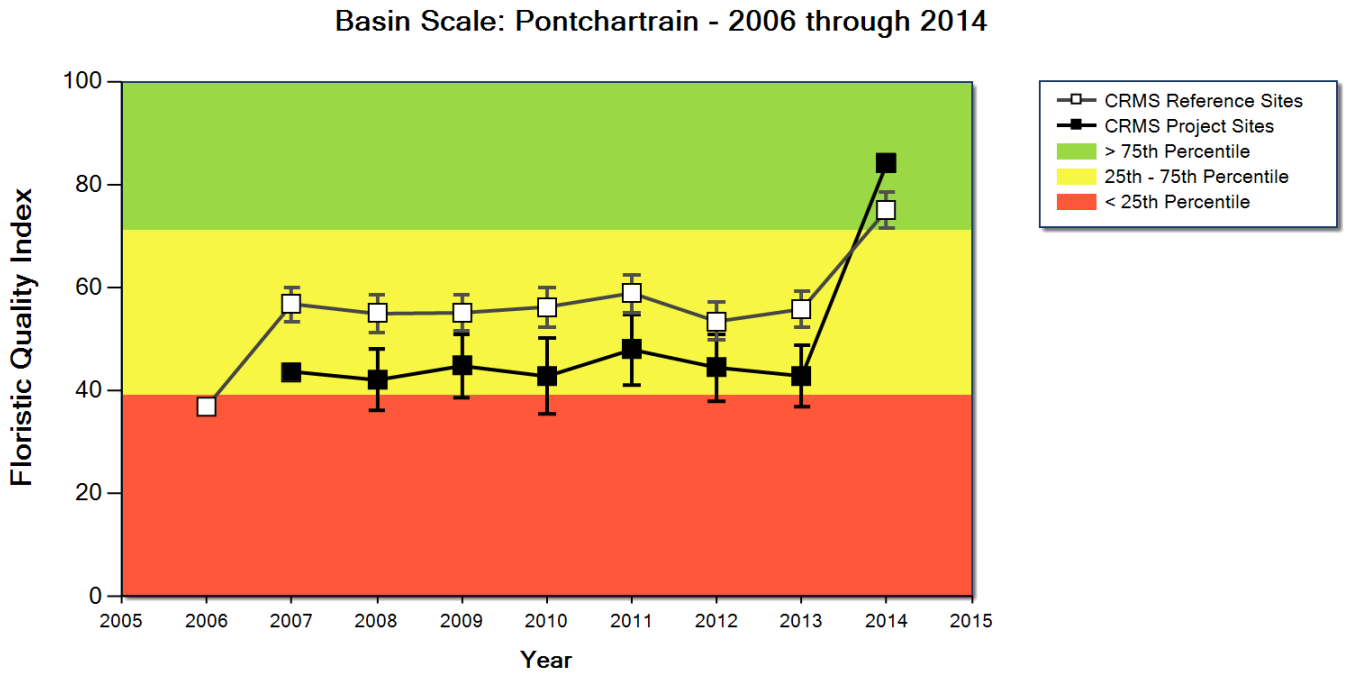

Figure 14. FQI scores within the Pontchartrain basin are shown over time. Project and reference site scores are the mean (± SE) FQI scores by year for all sites within Pontchartrain basin.

CRMS Project Sites - 2007 N = 11; 2008 N = 12; 2009 N = 12; 2010 N = 12; 2011 N = 12; 2012 N = 12; 2013 N = 12; 2014 N = 1

CRMS Reference Sites - 2006 N = 2; 2007 N = 41; 2008 N = 45; 2009 N = 46; 2010 N = 46; 2011 N = 46; 2012 N = 45; 2013 N = 45; 2014 N = 10

Basin Scale Assessment: Pontchartrain Hydrologic Index (HI)

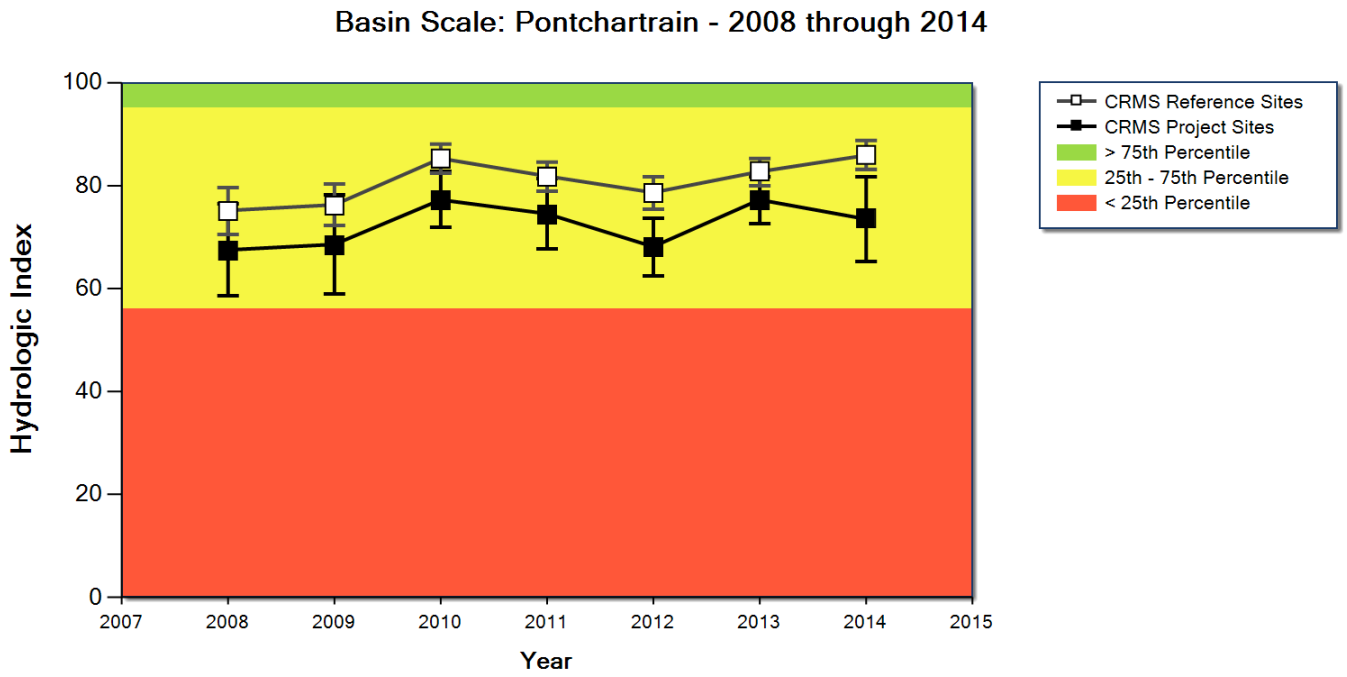

Figure 15. HI scores within the Pontchartrain basin are shown over time. Project and reference site scores are the mean (± SE) HI scores by year for all sites within Pontchartrain basin.

CRMS Project Sites - 2008 N = 8; 2009 N = 9; 2010 N = 10; 2011 N = 10; 2012 N = 11; 2013 N = 9; 2014 N = 8

CRMS Reference Sites - 2008 N = 28; 2009 N = 38; 2010 N = 42; 2011 N = 43; 2012 N = 42; 2013 N = 42; 2014 N = 38

Basin Scale Assessment: Pontchartrain Submergence Vulnerability Index

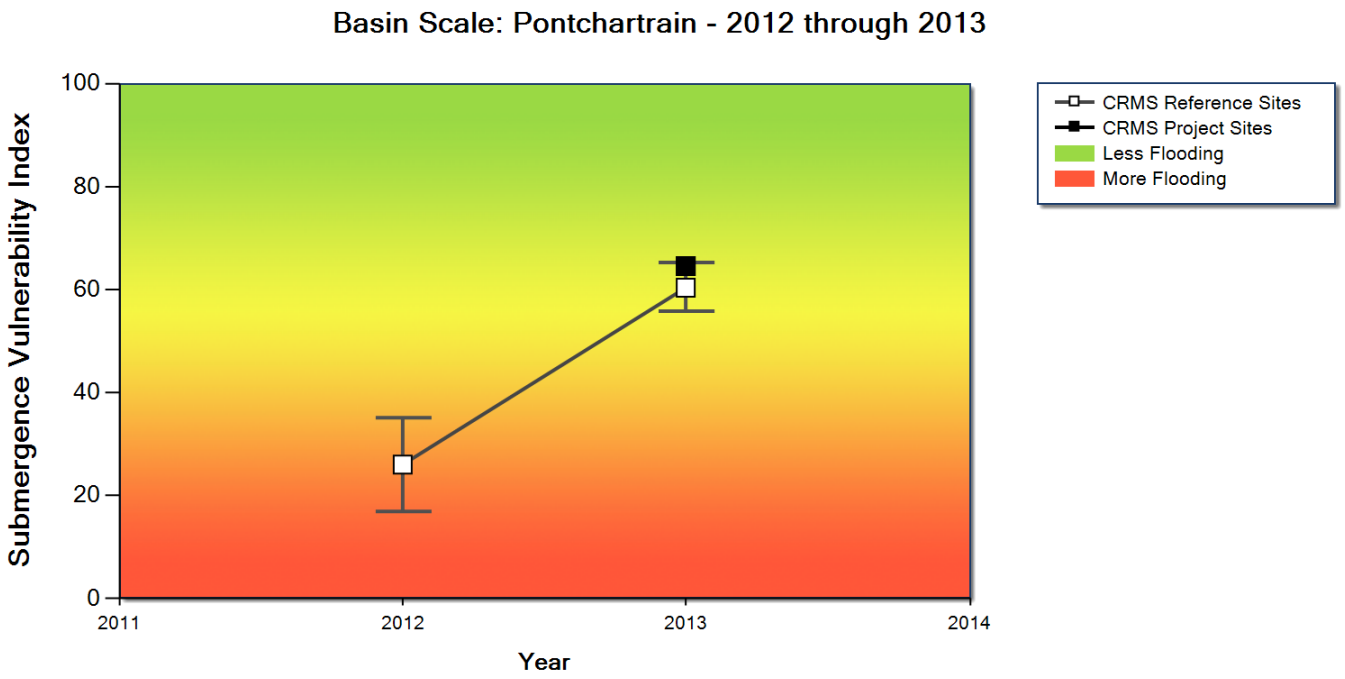

Figure 16. SVI scores within the Pontchartrain basin are shown over time. Project and reference site scores are the mean (± SE) SVI scores by year for all sites within Pontchartrain basin.

CRMS Project Sites - 2013 N = 4

CRMS Reference Sites - 2012 N = 3; 2013 N = 19

Coastwide Scale Assessment: Floristic Quality Index (FQI)

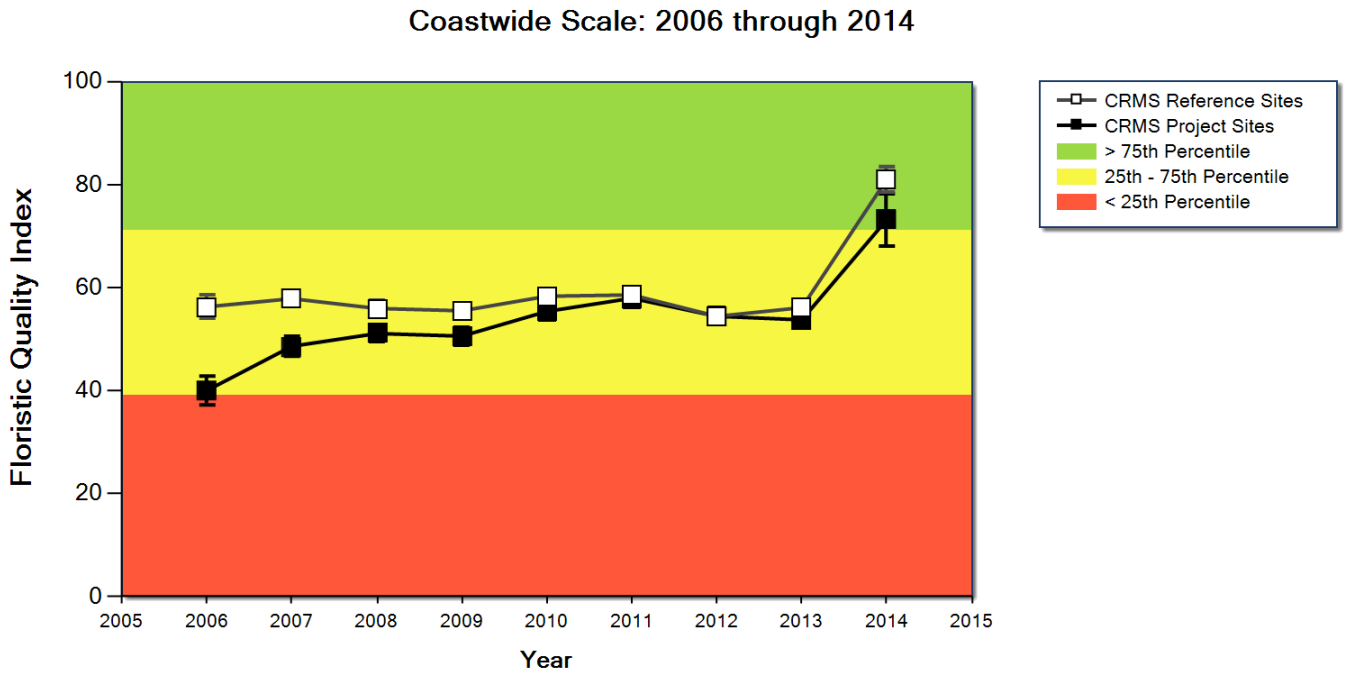

Figure 17. FQI scores across the coast are shown over time. The mean (± SE) FQI scores are calculated for all project and reference sites by year.
CRMS Project Sites - 2006 N = 74; 2007 N = 133; 2008 N = 142; 2009 N = 144; 2010 N = 136; 2011 N = 143; 2012 N = 143; 2013 N = 144; 2014 N = 8
CRMS Reference Sites - 2006 N = 121; 2007 N = 230; 2008 N = 239; 2009 N = 242; 2010 N = 237; 2011 N = 245; 2012 N = 244; 2013 N = 244; 2014 N = 25

Coastwide Scale Assessment: Hydrologic Index (HI)

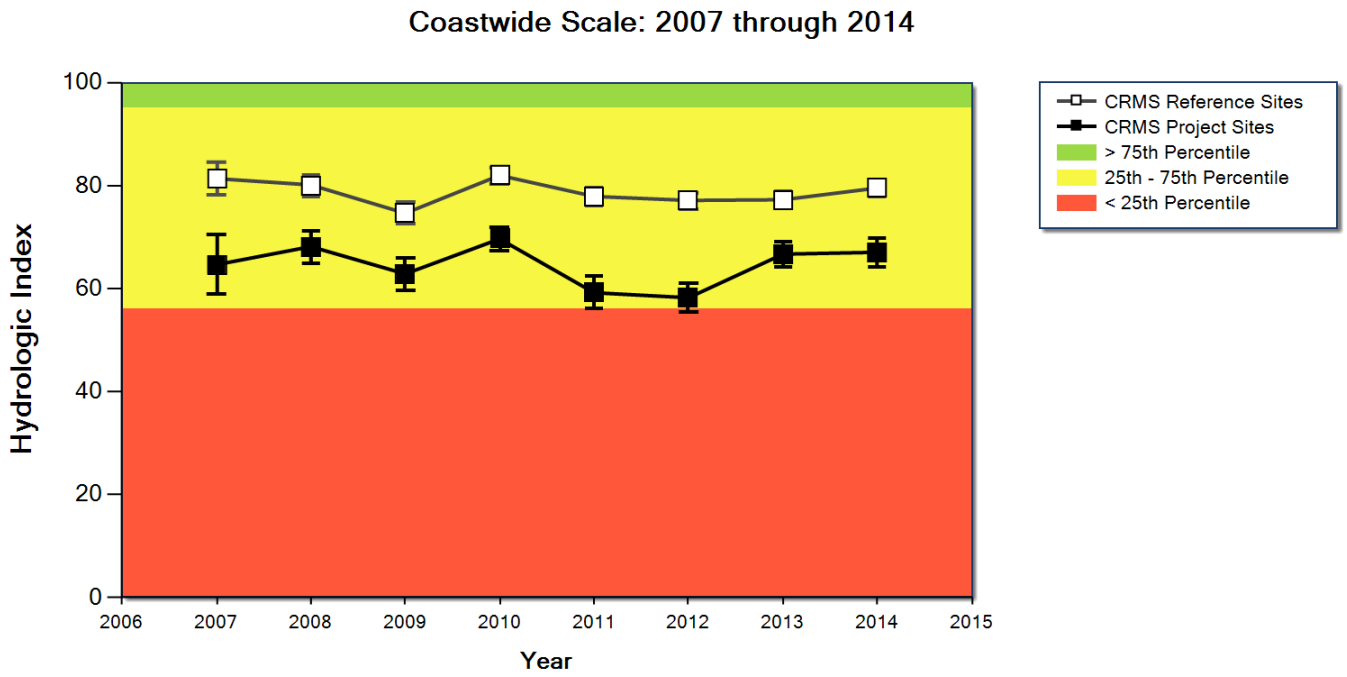

Figure 18. HI scores across the coast are shown over time. The mean (± SE) HI scores are calculated for all project and reference sites by year.
CRMS Project Sites - 2007 N = 26; 2008 N = 72; 2009 N = 92; 2010 N = 112; 2011 N = 121; 2012 N = 128; 2013 N = 125; 2014 N = 112
CRMS Reference Sites - 2007 N = 50; 2008 N = 131; 2009 N = 171; 2010 N = 200; 2011 N = 209; 2012 N = 214; 2013 N = 215; 2014 N = 198

Coastwide Scale Assessment: Submergence Vulnerability Index (SVI)

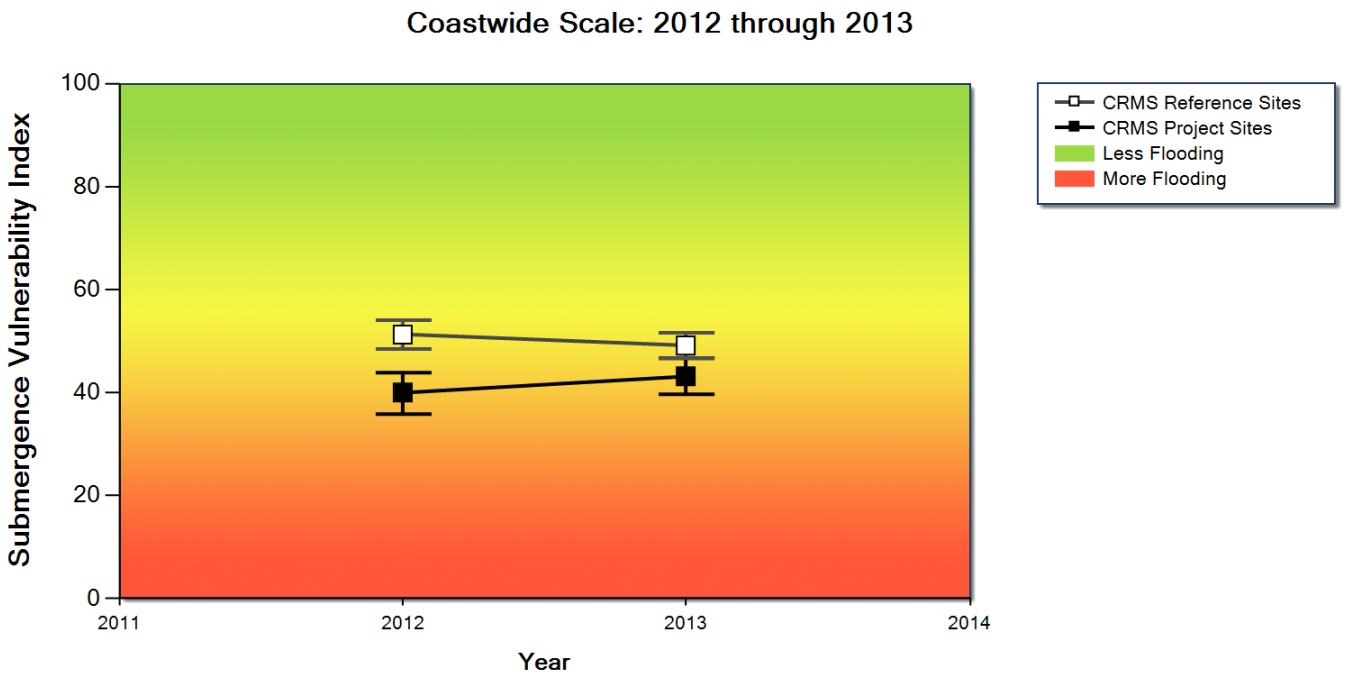

Figure 18. SVI scores across the coast are shown over time. The mean (± SE) SVI scores are calculated for all project and reference sites by year.
CRMS Project Sites - 2012 N = 58; 2013 N = 85
CRMS Reference Sites - 2012 N = 94; 2013 N = 137

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